the effectiveness of sensor placement in damage detection. The results demonstrate the high efficiency of the proposed method for detecting the location and severity of joint damage, considering noise effects. Besides, an inappropriate location of sensors causes some errors in damage detection procedure, and the method cannot easily identify the damage.

Key Words: Damage detection, beam to column connection, time domain response, differential evolution algorithm.

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Abstract

Waste stabilization ponds have been extensively used in the world for wastewater treatment. Due to their low cost and simplicity of operation and maintenance, stabilization ponds predominate among the small wastewater treatment systems. The low TSS removal efficiency of wastewater stabilization ponds is mainly due to the growth of algae in the maturation ponds. Aquatic plants, such as duckweed, can be successfully used to control algae in wastewaters. Consequently, the use of a modified type of waste stabilization ponds with a floating layer of duckweed on the surface has received growing attention. Duckweed is a floating aquatic plant within the family Lamnaceae that can easily be harvested, providing a potential economic resource as a dietary supplement and nutrient source for livestock. The major mechanism of duckweed plants in the reduction of algal growth is covering the wastewater surface to reduce light penetration. Accordingly, duckweed plants were used in this study. Wastewater effluent collected from maturation pond of Bushehr stabilization pond system was used to evaluate the duckweed plants' efficiency in improving the effluent quality, especially control of algal growth, in a field pilot. The pilot system including two ponds, the duckweed (Lemna gibba L.) inoculated treatment pond and the control one, was constructed under local outdoor natural conditions. Each pond had dimensions of 3m length, 0.5 m width, and 0.5 m depth. The system operated in a continuous mode with a residence time of 15, 10, and 5 days and TSS, COD, pH, EC, NO_3^-, PO_4^{3-}; total and fecal coliform was measured. The removal efficiency of duckweed pond was 64%-90% for TSS, 46%-56% for COD, 41%-51% for NO_3^-, 58%-71% for PO_4^{3-}, 97.2%-98.7% for total coliform, and 95.9%-99.2% for fecal coliform. The results show that duckweed plants were able to considerably improve the effluent quality, especially for TSS removal.

Key Words: Stabilization pond, wastewater treatment, duckweed, algae.

DAMAGE DETECTION IN BEAM TO COLUMN CONNECTIONS OF MOMENT FRAMES SUBJECTED TO IMPACT LOAD USING AN OPTIMIZATION METHOD

N. Pahnabi
m.p_omran@yahoo.com
S.M. Seyedpoor(corresponding author)
s.m.seyedpoor@gmail.com
Dept. of Civil Engineering
Shomal University
DOI:10.24200/J30.2018.2231.2142

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Abstract

Damage occurrence in all structural systems and their critical components is inevitable during their lifetime. Damage detection in structures is necessary for structural health monitoring, which can increase the safety. If the damage is identifiable in a way, damaged elements can be repaired or replaced and it can prevent the overall failure of the structure. Most of the damage identification methods are concentrated on detecting damage in structural members without considering damage at their connections that most have been seen. Beam to column connections of moment frames play an important role in their performance, because the performance of the structure mainly depends on the stiffness of the connections. Joint damage will change the stiffness of the structure, mass, and damping leading to a change in dynamic responses, such as displacement and acceleration. This principle can be used as a way to detect damage in connections. In this article, an optimization-based method for joint damage identification of moment frames subjected to an impact load is introduced. Spring model based connection simulation is used with flexible elements (springs), and converts the rigid joint to the semi-rigid one. Firstly, the beam-to-column connection in a steel moment frame structure is modeled by a zero length rotational spring at the end of the beam element. For each connection, an end-fixity factor is specified. This parameter has a zero value for a theoretically-pinned joint and a value of one for the theoretically-rigid one. The damage severity in any connection was defined as the reduction of the end fixity factor. Then, the problem of joint damage detection is transformed into a standard optimization problem. An objective function is defined using the acceleration of damaged structure and that of an analytical model obtained via the Newmark procedure. The optimization problem is solved by an improved differential evolution algorithm (IDEA) for determining the location and severity of the joint damage. Two numerical examples are considered to assess the performance of the proposed method and to check

satisfied plane strain conditions along void axes. For this purpose, poorly graded silica sand (SP) was used for the soil strata in the model tank and a thin plate of aluminum which coated with thin sand layer, was used to represent soil reinforcement. Performance of soil reinforcement was studied through the development of 15 different models. These models loaded sequentially by void air pressure reduction. Void air pressure and soil settlement at failure point, and also soil settlement after void collapse were measured to assess the performance of these models.

Experimental results indicated that the performance of reinforced soil was improved when the depth of reinforcement placement increased from the soil surface and the number of reinforced layers were added. The number of reinforcement layers that would improve the performance considerably was limited to a certain number (i.e. two layers in this study). Finally, the results indicated that using reinforcement with more width around the void area would improve soil stability in the model, but this improvement can only be significant under a certain reinforcement width to void diameter ratio (i.e. three times of the void diameter in this study).

Key Words: Soil reinforcement, underground void, experimental study, settlement.

EXPERIMENTAL INVESTIGATION ON BEHAVIOR OF SOIL BED CONTAINING RUBBER-SOIL MIXTURE LAYER

R. Zakeri
rzakeri@email.kntu.ac.ir
S.N. Moghaddas Tafreshi(corresponding author)
nas_moghadas@kntu.ac.ir
Dept. of Civil Engineering
K.N.ToosiUniversity of Technology
DOI:10.24200/J30.2018.2116.2093

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Abstract

The waste tire is one of the fastest growing industries in the world, as recycling them have become one of the major challenges worldwide. Successful use of waste rubber as rubber-soil mixture (RSM) in improving the soil properties is ensured in a given geotechnical application when appropriately used. The present study provides an approach for the use of granular rubber as rubber-soil mixture layer in soil backfill. The behavior of soil alone and reinforced soil by one layer of RSM was investigated by standard CBR apparatus with load rate of 1.27 mm/min on samples. The rubber used in the RSM layer was granulated rubber, produced from waste tires. Four sizes of rubber particles of 1.26, 2, 2.83, 4.76 mm, four rubber contents of 2.5, 5, 7.5, and 10% and three surcharges of 0, 2 and 4 kg were used. The provision of RSM layer might reduce the penetration of loading plate and increase CBR value. The results of the tests depict that the bearing capacity increases up to 75% by using the optimum rubber content of 7.5% in the RSM layer. Also the effect of RSM layer thickness of 1, 1.5, 2 and 3 cm on the behavior of sample was investigated. The results show that using the soil layer of 1.5 cm over RSM layer increases the bearing capacity of sample, especially for penetration of less than 5 mm. Overall; the results of tests demonstrate that the inclusion of waste granular rubber in soil with appropriate rubber size, rubber content and soil layer over RSM laye could improve the strength and deformation behavior of road beds substantially. On the basis of the study, the concept of using rubber-soil mixture layer not only improve the performance of shallow footings, embankment and road construction, but also, the environmental impacts of waste tires are attenuated by using as composite materials in civil works.

Key Words: Granular rubber, penetration, surcharge, rubber content, rubber size, top soil layer.

IMPROVING EFFLUENT FROM WASTEWATER STABILIZATION PONDS USING DUCKWEED

S. Saadat(corresponding author)
ssaadat@shirazu.ac.ir
H. Kolali Khormouji
h_kolali@yahoo.com
A. Karimi-Jashni
akarimi@shirazu.ac.ir
Dept. of Civil and Environmental Engineering
Shiraz University
DOI:10.24200/J30.2018.2033.2077

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ADAPTIVE FINITE ELEMENT ANALYSIS USING H-REFINEMENT AND INTERPOLATION COVER FUNCTIONS

H. Arzani(corresponding author)
h.arzani@sru.ac.ir
M. Ghorbanzadeh
Mehrshad.khaan@gmail.com
E. Khoshbavar Rad
Ekhoshbavarrad@gmail.com
Dept. of Civil Engineering
Shahid Rajaee Teacher Training University
DOI:10.24200/J30.2018.2140.2106

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Abstract

Nowadays, numerical methods are known to be effective solutions to scientific problems. The most popular numerical methods include finite difference method, finite volume method, finite point method, and the finite element method. The standard finite element method may go through difficulty with highly-curved boundaries, and it lacks enough accuracy. In this method, another challenge is to generate finite element mesh by proper numbers, types, and orders of elements. Aimed at decreasing the computational costs of discretization and increasing the solution accuracy, a suitable solution is of great importance in this method. This paper presents a method to improve the meshes and accuracy of solutions regarding elasticity problems. In this paper, two techniques of h-refinement and h-enrichment are used by interpolation cover functions. Initially, regions exceeding the value of allowable error are detected. Mesh improvement is done through h-refinement for the elements existing in those regions. The total error of the domain is, thus, reduced and limited to the allowable range. To increase the accuracy of solutions to an excellent level, the results of mesh refinement are reassessed in the next step, and the nodes exceeding the value of allowable error are determined. The method proposed here improves the region by interpolation cover functions and yields solutions of appropriate accuracy. The advantages of the proposed method include standard norm and its error determination, adaptive mesh generation, its validation for many 2D elasticity problems with extreme complexity within their domains, and automatic performance in both steps of h-refinement and determining the order of cover enrichment functions. This method can considerably reduce the computational attempts and properly enhance the accuracy of analytical results. This paper attempts to use fewer elements at the beginning and, then, introduces an individual generated indicator to determine the order of cover enrichment functions. In fact, it aims to suggest a method for automatic refinement in 2D problems. A comparison of solutions achieved by the proposed method with those of other approaches as well as the exact solutions for linear elasticity examples implies acceptable efficiency and accuracy of the proposed method.

Key Words: Mesh refinement, enriched finite elements, mesh generation, interpolation cover functions, adaptive analysis.

EXPERIMENTAL STUDY ON PERFORMANCE OF REINFORCED SOIL EMBANKMENT OVERLYING SHALLOW VOID

R. Pour Hosseini(corresponding author)
r_porhoseini@yazd.ac.ir
A. Salehi
a_salehi2002x@yahoo.com
K. Saeidnia
k.saeidnia@yahoo.com
Dept. of Civil Engineering
Yazd University
DOI:10.24200/J30.2018.2026.2070

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Abstract

Underground voids can cause many problems and dangers to the structures in urban areas and this issue can be intensified with time. These voids are made naturally or artificially and may be situated near or underneath of structures. Since shallow voids are located near to the ground surface, their impact can be extended to ground level and cause significant ground settlements or collapse of the voids. Soil reinforcement is currently utilized in the form of physical stabilization over the void crowns. The purpose of this research is to experimentally investigate the impacts of soil reinforcement arrangement on the performance of soil embankment and void stability. Therefore, a physical model designed with void diameter equal to 20cm and the scale of 1:50. The model

footing with anchor) are impractical owing to the necessity of thick base plates and numerous anchor rods. The bolts are cast into the concrete base in location tubes or cones and fit anchor plates to prevent pullout. High-strength grout is poured into the space below the plate. Column base connections are one of the most critical structural connections. Understanding the behavior and performance of these connections come in handy for designing this type of connections, especially in the seismic design of the structures. Such column bases are often only subject to axial compression and shear. However, uplift and horizontal shear may be a design case for column bases in braced bays. The way in which horizontal shear forces are transferred to the foundation is not well researched. Some designers check the resistance of the holding down bolts, and ensure that they are adequately grouted. This practice has been successfully followed for portal frame bases, which carry a significant shear. In column base connection, it can be said that the rotational stiffness is the only feature that links uncertainty in column base connection to structures such that a change in them can change rotational stiffness and, as a result, change the dynamic characteristics and seismic response of structures. In the present study, by considering the sensitivity mentioned above, the effects of rotational stiffness and the strength capacity of column base connection on behavior and seismic performance of steel moment frame have been evaluated by Modal Pushover Analysis (MPA) and Nonlinear Dynamic Analysis (NLDA) methods. The results show that the rotational stiffness of the column base connection effects on the dynamic properties of structures such as pushover curve, story drift, and ductility as well as the analysis of models together with different rotational stiffness showed that structures in combination with semi-rigid rotational stiffness are much better in designs.

Key Words: Column base connection, rotational stiffness, steel moment frame, MPA.

ANALYSIS OF CONDITION PHYSICAL HOMOGENOUS EARTH DAM IN OVER TAPPING

S. Salehi
Saeedsalehi100@gmail.com
E. Kahkesh
Ismaeil_kahkesh@yahoo.com
K. Esmaili(corresponding author)
esmaili@um.ac.ir
A. Arfa
Atefe.arfa@ymail.com

Dept. of Water Science and Engineering
Faculty of Agriculture
Ferdowsi University of Mashhad
DOI:10.24200/J30.2018.1984.2051

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Abstract

Dams failure by the over tapping from them is common that have property and environmental damage. So, this research scheduled for showing dam failure. For collecting soil mechanic parameters and them effects on time failure Used from experimental models such as downstream. Therefor in Laboratory were made earth dam models with similar downstream and upstream slopes that slops were 1:1 and 1:2 slop in down and upstream dam. For embanked models used three types of soil which one model constructed S soil and two models from SC soil). Six earths dam's models were made in glass flume. Soils used had 1.05, 0.51 and 0.07millimeter diameter average and respectively angle internal friction were 14, 18 and 23. Experiments were done with putting up head water in pound with maximum level. Score profiles were depicted while water passes was started in step of time. Accordingly, height and width of score gap determined with point gage and laser meter in time steps. In first model with coarse-grain soil showed that gap width of score was stable in passing time but height of gap is formed to waterfall which this height was changed accelerate. In this case score model was depth. Additional, in second model that prepared with 25 percent core soil (adhesive soil) and 75 percent fine soil (non-adhesive soil). During the time width gap was increased because energy lost from hydraulic jumps below slop couldn't overcame top of dam's models so score profile showed that water fall with high was formed floor of slop. This waterfall until dam failure was stable. Finally. By considering Mechanic Soil Parameter in Coulomb tension behaviors of dams was analyzed. Also, in third model that prepared with 50 percent core soil (adhesive soil) and 50 percent fine soil (non-adhesive soil) diagrams of score was depicted. In this model during the time score gap width was increased but in gap height was formed with several waterfalls. Height of waterfalls were less height from second model. This case was effect on dam failure. Generally, with increases average diameter and angle internal friction effect on decrease time failure and made increase. In addition, mount of score in models was calculated and was investigated.

Key Words: Failure earth dam, score, angle internal friction, downstream slop.

of the construction technology, this improvement technique can be considered as a practical method for improvement of strength behavior of clay in many fields of geotechnical engineering.

Key Words: Clay, shear strength, consolidation, nanosilica, soil improvement.

STUDY OF STIFFNERS GEOMETRY EFFECTS ON INCREASING ENERGY ABSORPTION OF DIFFERENT TYPES OF LINK BEAM IN ECCENTRICALLY BRACED FRAME

M. Mojarad
masoodmojarad@gmail.com
M. Daei(corresponding author)
m.daei@eng.ui.ac.ir
M. Hejazi
n.hejazi@eng.ui.ac.ir
Dept. of Civil Engineering
University of Isfahan
DOI:10.24200/J30.2018.2060.2080

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Abstract

The strength and stiffness of an eccentrically braced frame (EBF) can be similar to a concentrically braced frame, while simultaneously its energy dissipation capacity can be same as a moment resisting frame. In EBF, strength and stiffness are provided by braces and ductility and energy dissipation by link. Therefore, link beam is one of the most important key factor in the seismically response of EBF. In the strong earthquake, link beam is passed into the plastic zone and causes the other frame components remain elastic. In general, behavior of EBF is dependent on the link member design. Therefore it must be ductile enough to dissipate energy and prevent the collapse of frame. The link member is reinforced with stiffeners. The stiffeners delay local buckling of flange and increase cyclic ductility of the beam. Existing provisions for stiffeners design are developed based on short link beam behavior (shear behavior), and there are used for intermediate and long link beams regardless of bending considerations related to these types of link beams. In this paper, effects of geometrical properties of stiffeners and also link beam section are investigated for long, intermediate and short link beams. For this purpose, 25 link beams with different sections and lengths are simulated under static cyclic load by finite element software ABAQUS based on AISC seismic provisions. As a result, effects of different geometrical properties are discussed and suggestions for improving the energy dissipation of link presented. The results show that stiffeners tend to move towards the ends in the intermediate link beam and one of the stiffener can be removed in the short link beam. The stiffener thickness can not have a significant impact on the seismic response of link beam, while the efficient arrangement of stiffeners depend on the ratio of width to depth of beam section in long and intermediate link beams.

Key Words: Eccentrically braced frame, link beam, static cyclic loading, material failure index, dissipated energy.

ASSESSMENT OF THE EFFECT OF COLUMN BASE CONNECTION ROTATIONAL STIFFNESS ON SEISMIC BEHAVIOR OF THE STEEL MOMENT FRAMES

A. Sivandi-Pour(corresponding author)
a.sivandi@kgut.ac.ir
Faculty of Civil and Surveying Engineering
Graduate University of Advanced Technology
M. Gerami
mgerami@semnan.ac.ir
M. Taghdisi
m.h.taghdisi@gmail.com
Dept. of Civil Engineering
Semnan University
DOI:10.24200/J30.2018.2132.2103

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Abstract

Column base connections are commonly used to connect steel columns to concrete foundations in seismically designed Steel Moment Resisting Frames (SMRFs). These connections are economical for mid-to high-rise frames in which exposed base plate connections (affixed to the

M. Esmaeili(corresponding author)
m_esmaeili@iust.ac.ir
M.R. Roozbini
roozbini_90@yahoo.com
Dept. of Railway Engineering
Iran University of Science and Technology
S.R. Sourani
s.rasoul.s@gmail.com
Dept. of Civil Engineering
Iran University of Science and Technology
DOI:10.24200/J30.2018.2002.2058

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Abstract

Due to the procedure of increasing in axial load and speed on the existing railway tracks, need of improvement will be felt over the embankment. In this regard, one of the techniques is the use of geocell in the process of upgrading rail tracks. Therefore determination of the number of geocell's layers and alignment of their positions has a key role in this issue. Since influence of the number of layers and geocell's specifications on stability control and railway embankments' settlement are not specifically discussed in the technical literature, in this paper, by construction and loading of six embankments with m height in laboratory scale of , the influence of the number of geocell's layers with aperture size of 5×5 cm and height of 5 cm is studied on the stability of railway embankments. Modulus of elasticity of geocell by implementation of laboratory tensile test was obtained 70 MPa. Crown width and height of embankment in laboratory scale of 1:20, was considered 23 cm & 50 cm with slope of 1:1 respectively. After construction of separated embankments with adjusting one layer, after that two layers, until five layers, an increasing monotonic load with speed of 1.5 mm/min over embankment's crown until failure was applied. The results showed that the bearing capacity and control settlement of embankments was proportional to the number of geocell layers, as this process would increase until the four layers geocell, rather than decreased in the fifth layers. Bearing & settlement with four layers of geocell than embankment without any geocell had an increasing of 86.6% and a decreasing of 37% over embankment's crown, respectively. In all tests circular sliding surface was superficial & cutted the embankment at the top of slope that result in horizontal cracks at the levels of first & second layers over the embankment's slope.

Key Words: Geocell, railway embankment, stability of embankments, settlement control, bearing increase, laboratory model.

THE EXPERIMENTAL STUDY OF THE NANO-SILICA EFFECT ON THE STRENGTH AND CONSOLIDATION PARAMETERS OF KARAJ CLAY SOILS

A.M. Rajabi(corresponding author)
amrajabi@ut.ac.ir
Dept. of Engineering Geology College of Science, University of Tehran
A. Heidari Abdollahi
rayan_beton@yahoo.com
Dept. of Civil Engineering
Qom University
DOI:10.24200/J30.2018.2007.2061

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Abstract

Nowadays, improving problematic soils is considered as one of the geotechnical engineering challenges. Since the problematic soils have a secondary origin that are the results of chemical weathering, they have a wide range of dispersive characteristics. One of these types of soils is clay that causes many problems in the engineering project. These problems are related to their specifications, such as week strength, settlement, and dispersivity problems. One of the treatment methods of the mentioned problems is chemical soil stabilization. In this study, by adding nano-silica to a kind of clay in the city of Karaj (west of Tehran), the strength behavior of this type of soil was investigated. For this purpose, having conducted index and identification tests on the natural soil, we added nano-silica to the studied soil with 0.5, 1, 2, 3, 4, and 5 percent. Then, the direct shear, unconfined compressive strength, and consolidation tests were conducted on these soils. Moreover, imaging was captured by scanning electron microscopy (SEM) to evaluate and compare the textural features of the soil, before and after the stabilization process. The results show that adding nano-silica up to 2 percent leads to uniaxial compression strength enhancement, the shear strength parameters (including cohesion and internal friction angle), and reduction of the compressibility and swelling coefficients of the studied soil. In this study, it is clearly indicated that the technique of soil stabilized with nano-silica is a very effective method of ground improvement, which improves the shear strength, the unconfined compression strength, and the consolidation parameters of soil; consequently, it enhances the stability of structures, such as foundation and roadbed. With the development

measurement of the scour hole would lead to more properly designed pier foundation. In this study, by using laboratory equipment and field observation, evaluation of flow pattern in sharp bend with rigid bed and series of triplex bridge piers that are perpendicular on direction of flow proceeds. In order to measure three dimensional components of velocity, an ADV velocimeter was used. The Flume has width and curvature angle equal to 1m and 180 degree respectively. The ratio of the central radius by channel width is 2 so the flume belongs to Sharp bend group. In order to the creation of rough bed aggregates with an average diameter of 1.5 mm were gluing to the bed of the flume. Note that flow condition such as depth and discharge was chosen so that if an experiment is performed with live bed, the condition would be close to motion threshold. In this study, a series of the perpendicular pier were used at the position of 90 degrees and in direction of perpendicular on flow. This study has proceeded to the analysis of how formation of vortexes, content of length and width of channelized zone, dimensions of created vortexes at piers upstream and downstream, and the position of maximum velocity in various levels toward floor in plan. The most important results are that effecting zone of piers on separation zone of streamlines from each other in the longitudinal direction is 1.4 pier diameter to the upstream and 3.5 pier diameter to the downstream. Also in direction of perpendicular on flow, it is approximate 1.4 pier diameter to the inner bank of the first pier and 1 pier diameter to the outer bank of the third pier. The detailed discussion and conclusion of this study are presented in the main text of the paper.

Key Words: Flow pattern, triplex bridge piers, 180 degree bend, three-dimensional velocity, rigid bed.

OPTIMAL PERFORMANCE-BASED SEISMIC DESIGN OF SHEAR BUILDINGS USING ENDURANCE TIME METHOD

S.M. Miri
mohsen_miri467@yahoo.com
H. Tajmir Riahi(corresponding author)
tajmir@eng.ui.ac.ir
Dept. of Civil and Transportation Engineering
University of Isfahan
DOI:10.24200/J30.2018.1947.2033

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Abstract

Recently, with progress in earthquake engineering and design of structures, the performance-based seismic design is becoming more popular. However, finding the optimum structure that satisfies the performance limitation of this method is a hard task. In this study, the applicability of endurance time method in optimal performance-based design is evaluated using uniform deformation theory. First, shear building structures are optimized for a set of records, representing a specified seismic hazard level using time-history analysis and uniform deformation theory. This is done for a different number of stories ranging from 5 to 15. In addition, different target ductilities are used for uniform deformation procedure ranging from 1 to 8. Sets of ground motions used in this study are obtained from the SAC project and represent different seismic hazard levels. The results show that the optimized structure for a specific seismic hazard level does not necessarily show appropriate performance at other seismic hazard levels.

However, the performance of optimized structures for another set of ground motions with the same seismic hazard level is satisfactory. Consequently, using a try-and-error process, the structure's performance is improved to a certain extent; however, it is not yet ideal and also the stiffness of the structure increases. This process is time-consuming and insufficient for engineering application. Therefore, endurance time method is utilized to find optimal structures with a proper performance at different seismic hazard levels. ETA40g acceleration functions are used since they are more compatible with the ground motions used before. The results of endurance time method are compared with those obtained for ground motions. It is shown that the results of endurance time analysis are consistent with those obtained from time history analysis of the set of records. Distribution of story shears and deformations are compatible in two methods. Finally, an effective technique is presented in which the structural performance is simultaneously improved at all seismic hazard levels.

Key Words: Endurance time method, performance-based seismic design, seismic hazard levels, shear building, uniform deformation theory.

LABORATORY INVESTIGATION OF INFLUENCE OF GEOCELL ON THE STABILITY OF RAILWAY EMBANKMENTS

of wave propagation as well as accelerograph frequency content significantly affects the responses and amounts of strain in soils whose speed in hard soils with higher wave propagation is less than that of looser soil with lesser wave propagation.

Key Words: Steel pipeline, time history analyses, asynchronous analyses, vibration frequency, longitudinal wave propagation.

DEVELOPMENT OF DIFFERENTIAL QUADRATURE METHOD IN SINGLE-PHASE FLOW SIMULATION IN POROUS HYDROCARBON'S RESERVOIRS

A. Salehi
salehi.ashkan68@gmail.com
S.H. Meraji(corresponding author)
h.meraji@pgu.ac.ir
M. Vaghefi
vaghefi@pgu.ac.ir
Dept. of Civil Engineering
Persian Gulf University, Bushehr
DOI:10.24200/J30.2018.1939.2026

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Abstract

In order to calculate the accurate prediction of fluid pressure in the reservoir and hydrocarbon's reservoir's simulation, numerical methods were developed. Different numerical methods, including finite difference method (FDM), finite element method (FEM), boundary element method (BEM), and finite volume method (FVM), were used to solve various engineering problems. However, using these approximate numerical methods, the problem formulation becomes more complicated, and considerable computational effort is required to obtain acceptable solutions. To this end, researchers are always looking for more efficient and accurate numerical methods to increase the ability of numerical modeling. In this research, the development of the Differential Quadrature Method (DQM) in the fields of numerical simulation of hydrocarbon reservoirs and fluid flow in porous media is studied. DQM is a numerical method to solve nonlinear partial differential equations developed in the 1970s based on the integral quadrature. In the DQM model, partial derivatives of a function in one coordinate direction are set to the linear sum of weighted values of the function at all points along that direction. DQM has a simple formulation, low computational cost, and high accuracy with respect to other conventional numerical methods, employed frequently in various engineering fields. Fluid motion in a porous hydrocarbon reservoir is governed by partial differential equations. Several numerical methods have been used so far to solve these equations. In this study, differential quadrature method is used to solve the governing equations. For this purpose, several different flow simulations in a porous hydrocarbon's reservoir (including one-and-two-dimensional problems, compressible and incompressible stones, etc.) are considered. The obtained results and their degree of accuracy are compared with the already available analytical and numerical data found in the literature, and on that basis, it is concluded that DQM generates accurate results, is very easy to formulate and operate, does not need large mesh size, and is very time-efficient.

Key Words: Numerical simulation, hydrocarbon's reservoirs, differential quadrature method, porous media.

EXPERIMENTAL INVESTIGATION OF FLOW PATTERN AROUND SERIES OF TRIPLEX BRIDGE PIERS OF PERPENDICULAR ON DIRECTION OF FLOW IN 180 DEGREE BEND WITH RIGID BED

M.J. Tabib Nazhad Motlagh
javad.tabib@yahoo.com
M. Vaghefi(corresponding author)
vaghefi@pgu.ac.ir
S.Sh. Hashemi
sh.hashemi@pgu.ac.ir
Dept. of Civil Engineering
Persian Gulf University, Bushehr
DOI:10.24200/J30.2018.1978.2050

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Abstract

Bridge piers are highly susceptible and sensitive to scouring effects, so careful determination of scour depth and

Abstracts of Papers in English

THE EVALUATION OF P-WAVE PROPAGATION ON THE SEISMIC BEHAVIOR OF STRAIGHT STEEL PIPELINES IN LAYERED SOILS

A. Ghaznavi Oskouei(corresponding author)
amin.ghaznavi@gmail.com
A. Vatani Oskouei
asvatani@gmail.com
Dept. of Civil Engineering
Shahid Rajaee Teacher Training University
DOI:10.24200/J30.2018.1665.1916

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Abstract

The buried oil and gas pipeline is one of the most vulnerable infrastructures. Underground structures are among the most vital infrastructures, which include a variety of tunnels, subway lines, gas, oil, and water pipe. The analysis and design of gas and oil pipelines are of importance, because they are long and go through lands with various characteristics and that they are laid beside the faults and sometimes cross the faults. Various studies have already investigated the design process and the damages imposed on the pipelines crossing the faults. Moreover, plenty of studies have been devoted to the investigation of the effect of wave propagation method on the seismic behavior of steel pipelines. Underground structures are entitled to particular analytical conditions due to their length and continuity. Furthermore, their design and implementation are of utmost importance due to the high and strategic costs of repair and the threats and damages to the people's lives after the earthquake. This paper focuses on the three dimensional modeling of transmission pipelines with the length of 1000 meters, in a way that the effect of boundary conditions on the responses is insignificant. Nonlinear springs were employed to model the soil, considering the ASCE equations as well as taking soil-pipe slippage into consideration. This paper also aims to investigate the effect of (longitude) P-wave propagation on the amount of strain belonging to steel pipeline made of x60. To this end, MATLAB and ABAQUS software was used to carry out numerical analysis. The results show that the speed